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ABSTRACT

This paper presents an overview of the biological sciences, the number of women involved, and the opportunities available to them. Some of the women who attained prominence in biological sciences since the early days of women's college education are presented. Data and figure captions are presented to show the gains of women in biological sciences. The author states that women are earning an increasing percentage of the doctorate degrees awarded in nearly all fields; substantial numbers of women are found in the lower ranks of the academic faculty; the percentage of women consultants on review committees and councils has increased significantly since 1971 and more women in biological and medical sciences are applying and receiving research grants. It is also stated that women's salaries still lag somewhat behind those of men, few women are found at the top in decision-making positions, and fewer still receive accolades - honors and awards - of any kind. (Author/HM)

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Women in the Biological Sciences

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Elizabeth M. O'Hern

National Institute of General Medical Sciences

National Institutes of Health

SE 025 100

WOMEN IN THE BIOLOGICAL SCIENCES

Elizabeth M. O'Hern, National Institute of General Medical Sciences

This is an overview of the Biological Sciences, the numbers of women involved and the opportunities available to them.

Women have been attracted to the Biological Sciences since the early days of women's college education over a century ago. Some of the women in the Biological Sciences attained prominence, e.g., Nettie Stevens in Zoology whose work on the X and Y chromosomes was published in 1905,[1] Florence Sabin[2] (Anatomy) whose first paper on the lymphatics published in 1901 earned her a prize of the Naples Table Association in 1903.

Somewhat later, Alice Evans' critical research[3] and observations on brucella launched her into a decade or more of dispute with the dairymen. If we count Jane Colden [1] (1724-1766) who learned botany as an apprentice to her father, then it can be said that in the United States there have been prominent women in the Biological Sciences for more than two centuries. The first three editions of American Men of Science (1906, 1910 and 1921) listed some 504 individual women of whom about 50% could be counted in Biological or Medical Sciences.[1]

Substantial numbers of women earned doctorates in the Biological Sciences during the 1920's, reaching approximately 20% of the total.[4] Although the numbers increased during the next three decades, the proportion decreased and it was not until the 1950's and 1960's that the percentage of doctorates awarded to women in the Biological Sciences showed an upward trend (Figure 1). The increase has been almost universal, in the totals for all fields, for the Life Sciences, (which includes the Agricultural, Medical and Biological Sciences). The ratio between degrees awarded to women and total number of degrees is narrowing in each category. The numbers involved are:

Fig. 1

from 9,734 total for all fields in 1960 to 32,923 in 1976, increasing from 10.7% women in 1960 and 23.3% in 1976; from 1,728 total in Life Sciences in 1960 to 4,971 in 1976, the percent women increasing from 8.9% to 19.5% and 1,181 total in Biqlogical Sciences in 1960 to 3,245 in 1976 with the percent women rising from 11.9% to 23.2%.

Progress has not been uniform among specific fields of the Biological
Fig. 2 Sciences as is evident in Figure 2. The Biological Sciences depicted as a solid line, showing a steady rise (from 11.9% in 1960 to 23.2% in 1976). The fields of Biochemistry (from 14.3% to 22.9%), Botany (10.2% to 21.5%), Microbiology (13.6% to 25.9%) and Genetics (12.3% to 30.8%) made good gains.
Fig. 3 These are all large fields. But not all large fields made large gains (Figure 3). Zoology made no overall progress (from 15.4% women in 1960 to 16.7% in 1976). Biophysics (from 13.0% in 1960 to 16.3% in 1976) produced few women doctorates during much of the period, fewer than 10% of the total for many years. Others made moderate progress: Anatomy (from 17.6% in 1960 to 26.3% in 1976); Animal Physiology (from 14.3% in 1962 - with few women doctorates before then - to 18.6% in 1976); Plant Physiology made considerable gain (from 10.3 in 1962 - with few women doctorates before then - to 23.0% in 1976). Molecular Biology, newly included in 1969, started with 21.1% women among the doctorates granted in this discipline, and increased to 29.1% in 1976. Similarly, Immunology, tabulated separately in 1972, started with and has maintained a high percentage of women doctorates (about 33% women in 1972 and 1976).

Among graduate and postdoctoral students appointed to training grants supported by the National Institute of General Medical Sciences (NIGMS) 1967 through 1975, the proportion of women appointed as predoctoral trainees

has been equal to or greater than the proportion of all doctoral recipients who are women (Table 1). Among the postdoctoral trainees there has been an overall increase in percentage of women appointed and a generally increasing percentage among the individual fields, but the 1972 cutback and phaseout of some fields of training is particularly striking in the low numbers of postdoctoral appointments of 1973.

Tab. 1

We do not yet have information on the numbers of appointed predoctoral trainees who completed this training and received a doctorate. The data are available in the doctoral record file at the National Academy of Sciences. A number of concerned people at the National Institutes of Health (NIH), the National Science Foundation (NSF) and the National Research Council (NRC) are making a very careful and determined study of the legalities of getting at this sorely needed data under the restrictions of the Privacy Act.

Tab. 2

To compare the number of doctorates and trainees with academic positions available, Table 2 presents data compiled by the American Council on Education pertaining to young faculty in a sample of departments within the Biological Sciences, with projections for 1980.[5/] The data show that 30% or more of the present academic faculties are comprised of young faculty members (defined as having received their doctorates within the past seven years). Among the total faculty in the Biological Sciences there were, in 1975, approximately 225 positions in Biochemistry and in Microbiology, 500 in Biology, 200 in Zoology, 275 in Physiology, and 125 in Botany. Only 25-30% of the positions are held by young, that is, new, faculty (both men and women), and the projections for 1980 are not much different.

Tab. 3

Table 3 presents American Association of University Professors (AAUP)[5/] data for 1974-75, 1975-76, and 1976-77 on proportions of women in the various

various academic ranks for all fields. Women comprise nearly 30% of the assistant professors, only about 18% of the associate professors and about 10% of the full professors. The percentage of full professors who are women shows a decreasing trend. The discrepancy between men's and women's salaries increased from 1974 to 1976 at all ranks except full professor - the few women at this rank (8.4%) improved in salary status in 1976-77 (8.5% less than men's salaries) relative to 1974-75 (9.2% less).

Tab. 4 To move to some specific examples within the Biological Sciences, Table 4 presents data from the American Society for Cell Biology (ASCB) 6/ survey of 1976. There were a total of 1584 usable responses to the questionnaire which represents 54% of the society membership. Responses were anonymous so no follow up was possible. Women represent 23% of the respondents and 21.7% of the academic cohort. The top row (Table 4) indicates the total number of respondents in each experience cohort. The first column shows the totals for each rank; not all ranks are included (lecturers were omitted). Among the total academic cohort, 17.6% of the women and 38.5% of the men are full professors. As we move across the chart (Table 4) from the less to the more experienced cohorts, the percentage whp are full professors increases, as might be expected. Thus, 64.3% of the women and 87.8% of the men with 25 years of experience are full professors.

With respect to associate professors, 26.9% of the women and 29.7% of the men in the academic cohort are found in this rank. The highest percentage occurs at 10-14 years experience for both women and men. The numbers dwindle thereafter but the percentage remains high for women but drops sharply for men, who presumably have moved on to be full professors.

With respect to assistant professors, 31.4% of the women and 23.7% of the men are found in this rank. Beyond ten years of experience the numbers

and percents decrease considerably for both women and men. Most have moved up or out.

With respect to research associates, 20.4% of the women and 6.9% of the men are found in this rank. A sizeable percentage of women (though a small number of respondents) remain in the research associate category at all experience levels.

Tab. 5 Table 5 from the same ASCB Survey shows that nearly 22% of the respondents employed in professional schools of Medicine, Dentistry or Veterinary Medicine are women (78% are therefore men). Small numbers of the respondents are employed in colleges, the largest numbers are in the professional schools and universities. In general (college and government excepted), the highest percentages of women are found in the first two experience cohorts, with less than 10 years experience. This may be a reflection of the increasing pool size, but one must keep in mind that ASCB is a young society organized in the early 1950's. With respect to salaries, women seem to fare best in government employment.

Another example comes from an unpublished 1976 survey made by the

Fig. 4 American Society for Microbiology (ASM). Figure 4 presents graphically the ratio of women to totals for the faculty, staff, graduates and postdoctoral students. The survey format (a data-cell questionnaire for each category, at five year intervals) was mailed to chairpersons of 322 departments. The response was about 45%. The data in Figure 4 are shown in logarithmic form to accomodate the large number of students. The first interval histogram, 1950-51, shows the expected rising percentage of women among tenure track faculty as the position status decreases. There is greater variation in subsequent intervals, but a decrease in percentage of women chairpersons,

with the actual values being: 42 chairpersons in 1950-51 (only two of whom were women) increasing to 143 chairpersons in 1976-77 (with still only two women among them); 50 professors in 1950-51 (5.8% of them women) increasing to 495 professors in 1975-76 (6.9% of them women). Among associate professors the percentage of women increased from 13.3% in 1950-51 to 17.6% in 1975-76. The percentage of women among instructors increased from 29.0% in 1950-51 to 39.7% in 1975-76. The percentage of women in research professors category increased from none in 1950-51 to 30.7% in 1975-76. In the research associate category the percentage of women has been over 30% for most of the time intervals. Data on this particular group (non-tenure track academic personnel) are included in the ASCB survey.[6] A study of the status of non-tenure track personnel, with respect to their opportunities for obtaining research grants independently, as principal investigators, has been undertaken by the American Council on Education for the NIGMS. It will soon be published under the title "Nontenure Track Personnel: Opportunities for Self-Initiated Research".[7]

Tab. 6 One of the indicators of success - consultant status on NIH and other federal agency review groups and councils - has been strongly positive in recent years, as Table 6 depicts. Jumping from a lonely 2.9% in 1971 to 20.5% in 1976, the number of women consultants shows a remarkable increase, which is in large measure the consequence of concerted efforts on the part of professional women's committees and caucuses. Still short of the 30% goal once sought, the proportion of women in the last year shows a slight decrease. Whether this decline represents exhaustion of the pool of qualified women, or whether it is significant at all, can be evaluated better when figures for 1977 and 1978 are available.

Tab. 7 Data on another indicator of success, the receipt of research grants, are presented in Table 7, which shows the total number and percent distribution by sex of grant applications received by the NIH Division of Research Grants (DRG) for 1974 through 1977. An increasing proportion of the applications were received from women, 8.3% in 1971 to 10.0% in 1977 (for many earlier years the percentage had hovered around 5%). The approval rate and award rate are largely in line with the application rate. Similarly, the percent of applications recommended for approval tends to be nearly the same for women and men. The percentage of awards to women has improved from 1974 to 1977. The percent of applications received that have been recommended and then awarded shows a similar pattern. The number of awards that can be made depends upon available funds, funds committed for ongoing grants and upon the total number of applications received. In any event women's applications were about as successful as those of men in 1977. These data refer to new applications of all kinds, including new research proposals from previous investigators. The percent of women among successful first-time applicants has increased from 6.2% in 1966 to 11.7% in 1974 and 11.3% in 1975.

Women in the Biological Sciences have made certain gains; they are earning an increasing percentage of the doctorate degrees awarded in nearly all fields; substantial numbers of women are found in the lower ranks of the academic faculty; the percentage of women consultants on review committees and councils has increased significantly since 1971 and more women in Biological and Medical Sciences are applying for and receiving research grants. However, women's salaries still lag somewhat behind those of men, few women are found at the top in decision-making positions, and fewer still receive the accolades - honors and awards - of any kind.

To expand the role of women in the Biological Sciences, more factual information is needed to dispel the myths[8] about their exact status. Quite a number of the professional societies have recently elected a woman president (e.g., American Physiological Society, American Society for Biological Chemistry, American Society for Cell Biology, and the American Society for Microbiology) but few have surveyed their membership. Of those which have surveys in progress there is little or no information on the effect of discontinuities in employment, part-time employment and immobility on productivity, salary differentials and awards and honors. One need not ask the effect of unemployment on productivity and professional self-confidence, but we should have more precise data on the extent of unemployment among women and how much of it is voluntary. The excellent registries such as those of American Society for Biological Chemistry and the Association for Women in Sciences are providing a great service for women but they need to be expanded. They also need feedback on the numbers of women actually offered positions, the numbers who have declined positions, and why. In the face of retrenchment and contraction in numbers of academic positions can we expect young women to continue to make the effort to get doctorate degrees in the Biological Sciences? Are they sufficiently motivated to face the half-open door of science? A strong support system among women scientists is needed to maintain the gains made and overcome the obstacles[9][10][11][12] which remain.

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(Continued)

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FIGURE CAPTIONS

Figure 1 - Earned doctorates, United States Universities, 1960-1976: All Fields, Life Sciences, Biological Sciences. From: National Research Council Summary Reports.

Figure 2 - Percent Among Earned Doctorates to Women in Biological Sciences, Selected Fields (Biochemistry, Botany, Microbiology, Genetics) 1960-1976. From: National Research Council Summary Reports.

Figure 3 - Percent Among Earned Doctorates to Women in Biological Sciences, Selected Fields (Biophysics, Anatomy, Physiology, Zoology) 1960-1976. From: National Research Council Summary Reports.

Figure 4 - Status of the Profession: Microbiology. From American Association for Microbiology, unpublished.

Table 1 - New Appointments to National Institute of General Medical Sciences Training Grants: 1967-1975, total and percent women. From: National Institute of General Medical Sciences: Office of Program Planning and Evaluation.

Table 2 - Full-Time Doctorate Faculty and Young Doctorate Faculty in Selected Science Fields: 1975 and 1980 (Estimated). Adapted from: Atelsek, F. & I. Gomberg. 1976 (Aug). Nontenure track personnel: Opportunities for self-initiated research. Higher Education Panel Survey Report No. 30. Higher Education Panel Survey.

Table 3 - Status of the Profession: University Professors. From: American Association of University Profesors, Report on the Status of the Profession, 1976-77.

Table 4 - Status of the Profession: Cell Biology, Rank versus Experience. From: Clutter, M. E., S. E. Baldwin, K. M. Baldwin, B. Bowers and E. M. O'Hern, Profile of a Professional Society. In manuscript.

(Continued)

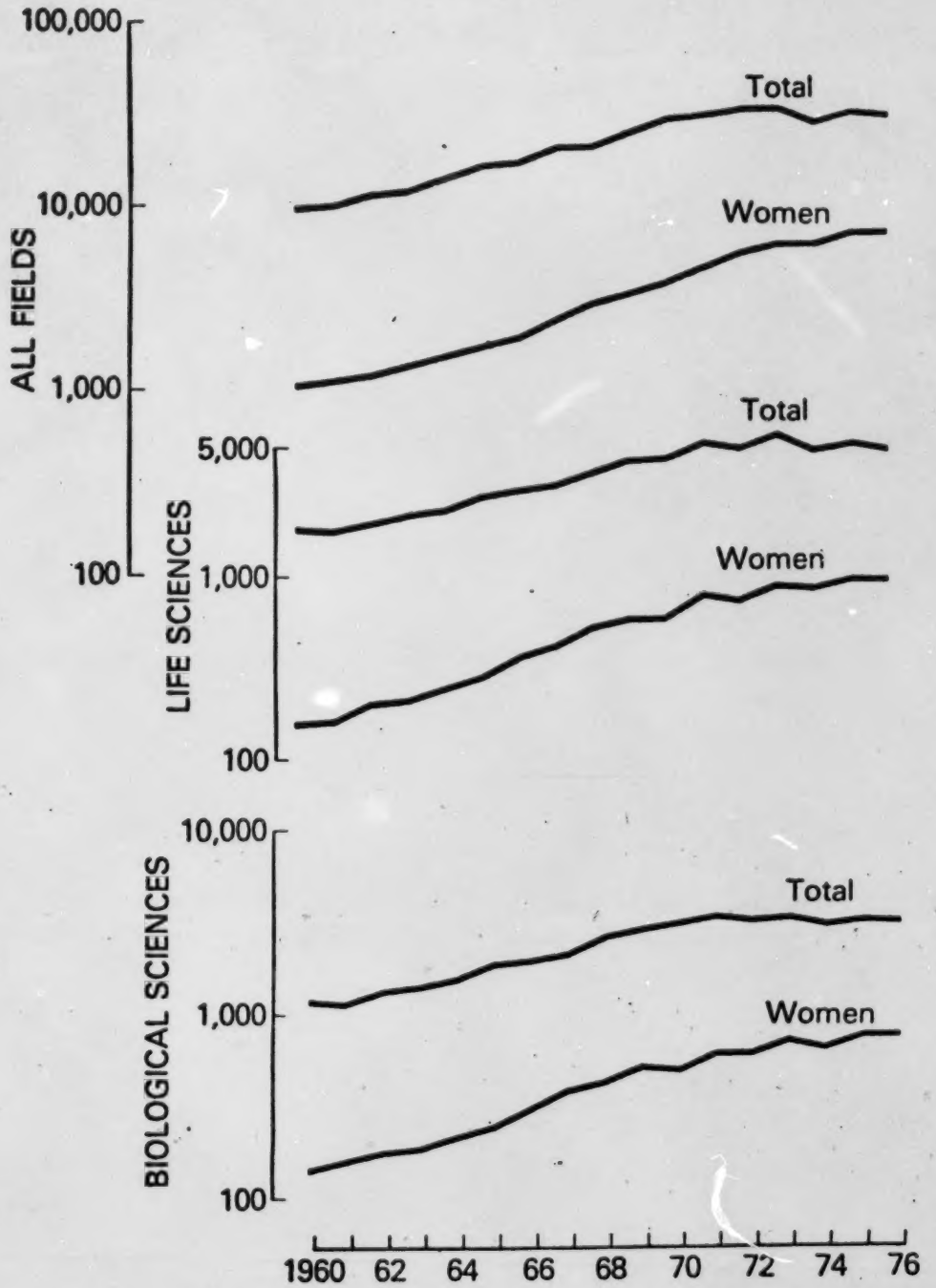
Page 2 - Figure Captions

Table 5 - Status of the Profession: Cell Biology, Employer Type. From: Clutter, M. E., S. E. Baldwin, K. M. Baldwin, B. Bowers, & E. M. O'Hern. 1978. Profile of a professional society. In manuscript.

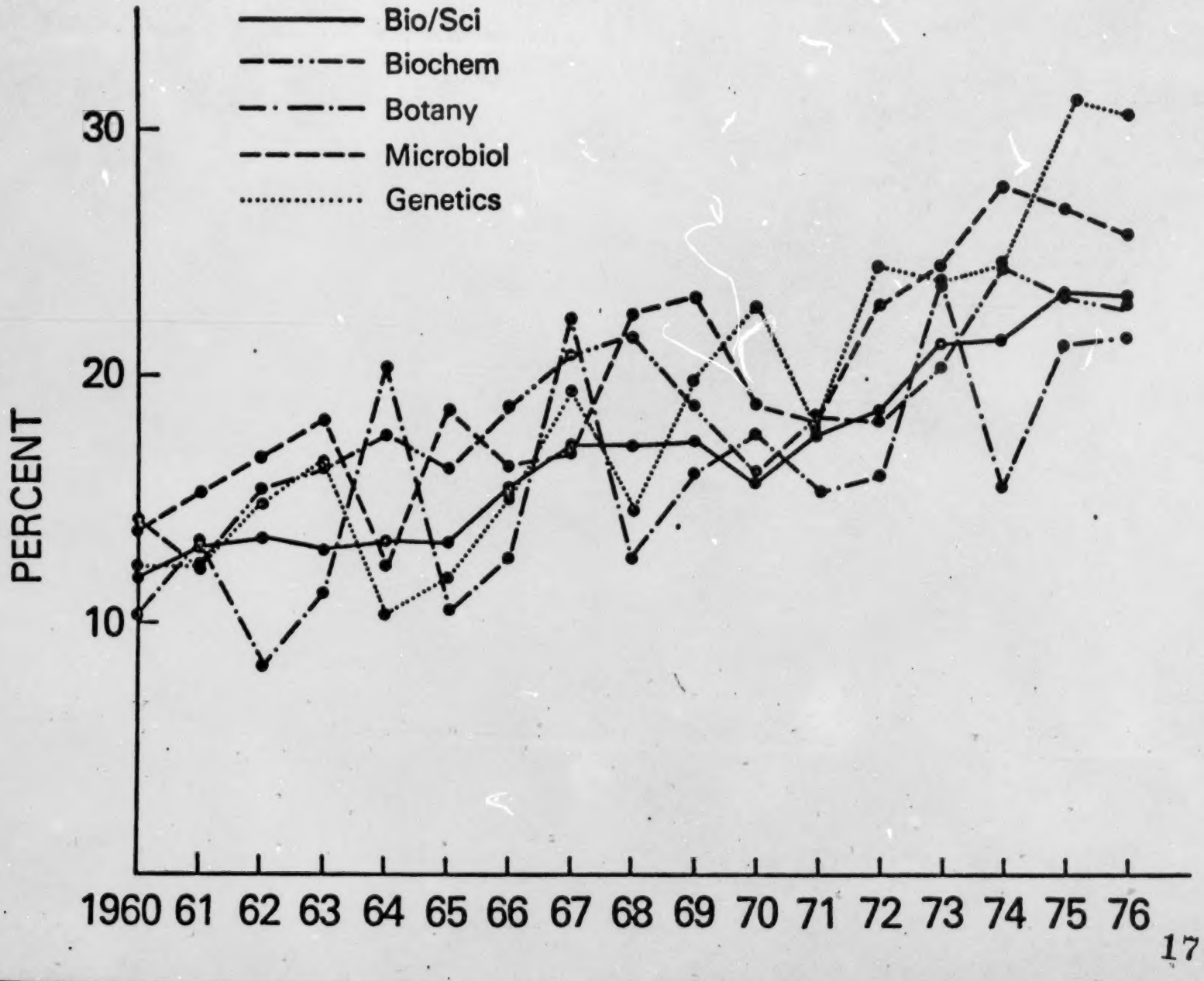
Table 6 - Women Members on National Institutes of Health Public Advisory Committees. From: NIH Committee Management Office.

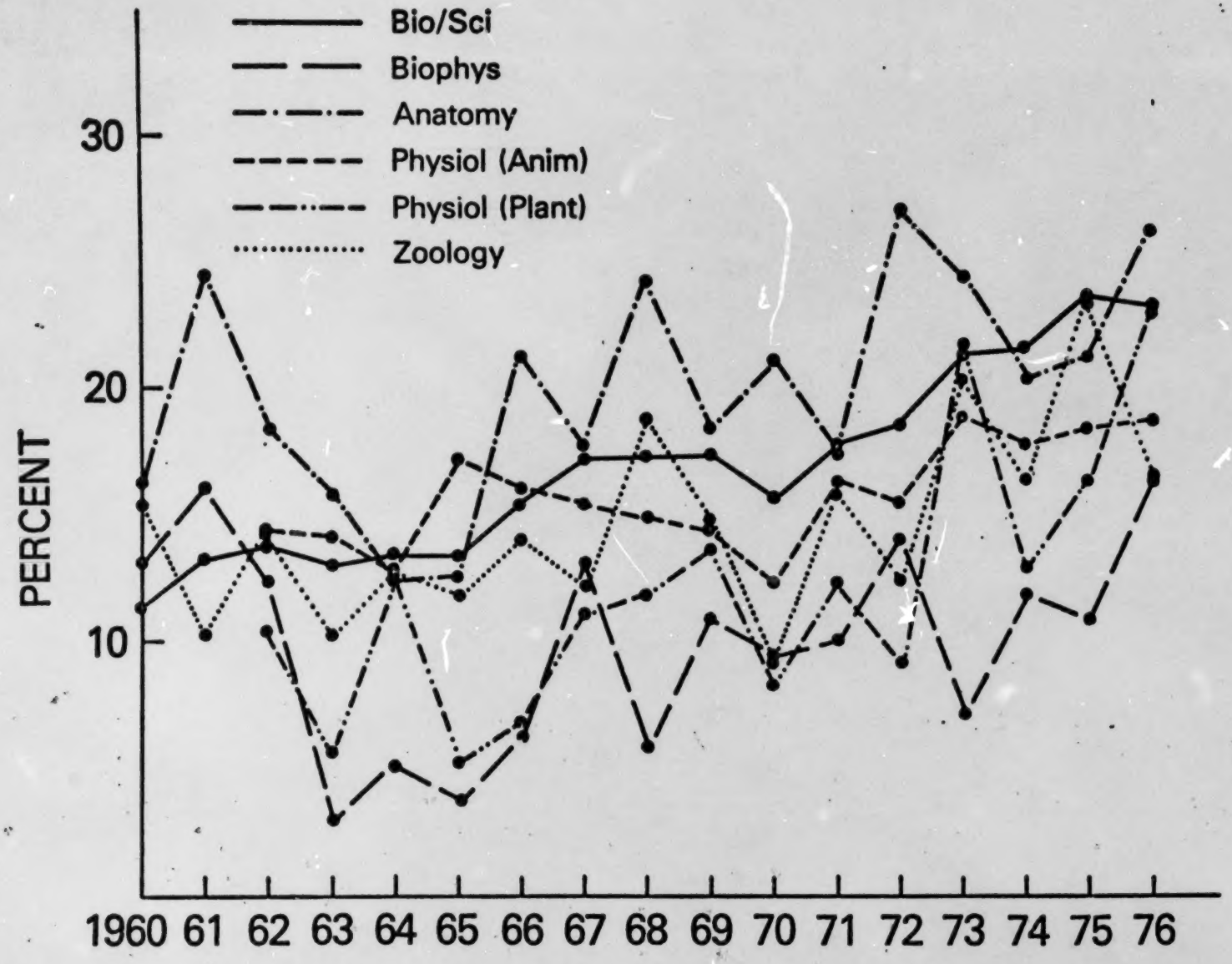
Table 7 - National Institutes of Health Competing Research Projects: Applications Received, Recommended and Awarded. From: NIH, Division of Research Grants, Statistics and Analysis Branch.

EARNED DOCTORATES U.S. UNIVERSITIES
1960 - 1976



From: NRC Summary Report:
Doctorate Recipients from United States Universities


Bio/Sci
Biochem
Botany
Microbiol
Genetics
30
20
10
PERCENT
1960 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76


Bio/Sci
Biophys
Anatomy
Physiol (Anim)
Physiol (Plant)
Zoology
PERCENT
30
20
10
1960 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76

NIGMS POSTDOCTORAL TRAINING

New Appointments

	1967		1969		1971		1973		1975	
	T	%W	T	%W	T	%W	T	%W	T	%W
Biological Sciences	165	17.0	146	19.9	110	14.5	38	13.2	85	25.9
Anatomy	18	22.2	16	37.5	14	21.4	2	50.0	7	28.6
Biochemistry	33	21.2	17	5.9	12	25.0	1	0	8	37.5
Biophysics	25	12.0	18	22.2	17	11.8	2	0	10	10.0
Biomet/Epidem	13	7.7	21	9.5	24	20.8	4	0	18	16.7
Genetics	27	18.5	30	30.0	22	9.1	14	28.6	25	28.0
Multidisc. Biology	20	15.0	11	27.3	5	0	4	0	3	66.6
Microbiol	15	26.7	19	15.8	6	0	0	0	8	25.0
Physiology	14	7.1	14	7.1	10	10.0	1	0	2	0
Cell Biology									4	50.0

NIGMS PREDOCTORAL TRAINING

New Appointments

	1967		1969		1971		1973		1975	
	T	%W	T	%W	T	%W	T	%W	T	%W
Biological Sciences	1340	26.2	1223	27.9	1035	29.4	524	30.5	793	29.4
Anatomy	124	31.5	105	34.3	70	30.0	36	25.0	28	39.3
Biochemistry	369	24.1	388	24.2	313	24.3	162	27.2	155	32.9
Biophysics	141	11.3	134	26.1	111	24.3	54	13.0	52	25.0
Biomet/Epidem	153	25.5	66	21.2	54	38.9	23	26.1	28	32.1
Genetics	143	35.0	107	32.7	109	42.2	57	47.4	81	48.1
Multidisc. Biology	122	30.3	165	33.9	144	29.2	43	48.8	78	37.2
Microbiol	149	32.9	111	33.3	124	34.7	88	30.7	208	28.4
Physiology	139	23.0	147	23.1	110	25.5	61	31.1	48	31.3
Cell Biology									115	31.3

National Institute of General Medical Sciences: Office of Program Planning and Evaluation.

FULL-TIME DOCTORATE FACULTY AND YOUNG DOCTORATE FACULTY IN SELECTED SCIENCE FIELDS: 1975 AND 1980 (Estimated)*

All Departments

Field	Number of Departments	December 1975			1980 Estimated		
		Total # Faculty	Young Faculty		Total # Faculty	Young Faculty	
			#	% of T		#	% of T
Biochemistry	72	1,005	224	22.3	1,121	279	24.9
Biology	67	1,740	502	28.9	1,930	504	26.1
Botany	32	507	127	25.0	539	120	22.3
Microbiology	70	822	224	27.3	971	270	27.8
Physiology	56	869	269	31.0	961	282	29.3
Zoology	32	688	197	28.6	735	177	24.1

*Atelsek, Frank J. and Gomberg, Irene L., Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980, American Council on Education, August 1976.

AMERICAN ASSOCIATION OF UNIVERSITY PROFESSORS DATA ON STATUS OF THE PROFESSION*

	Percentage Who are Women			Percentage Difference Between Average Salaries		
	1974–75	1975–76	1976–77	1974–75	1975–76	1976–77
Professor	10.1	9.1	8.4	9.2	9.6	8.5
Assoc. Prof.	17.3	16.6	16.7	3.8	4.8	4.4
Asst. Prof.	27.9	27.9	29.7	3.8	4.3	4.5
Instructor	48.0	49.3	49.0	4.5	5.1	5.4
Lecturer	41.4	41.2	41.9	–	–	–
All Ranks	22.5	21.7	22.4	17.4	19.2	19.3

*Report on the Economic Status of the Profession, 1976–1977.

CELL BIOLOGY*

Rank Versus Experience

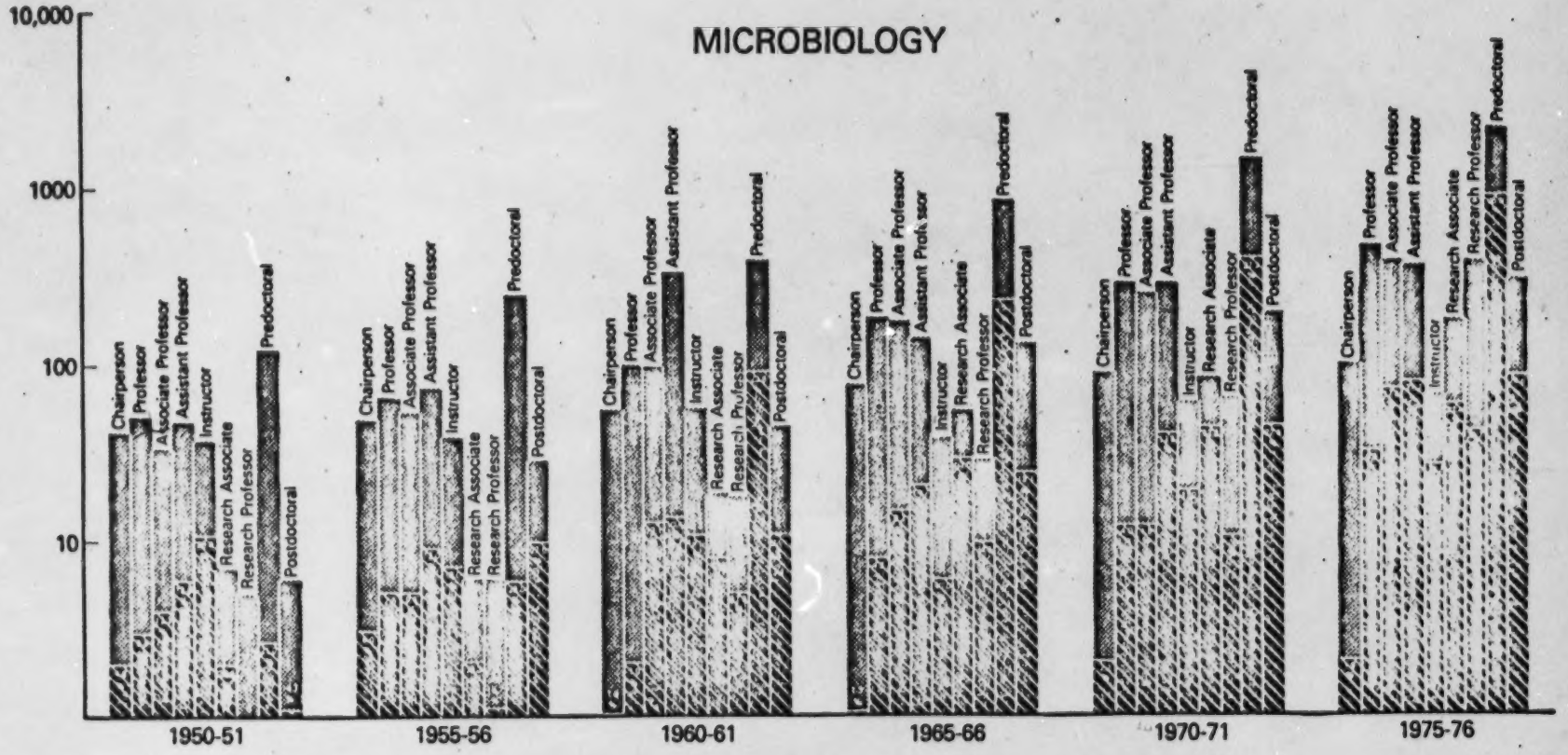
	Total	Under 5 Years	5–9 Years	10-14 Years	15-19 Years	20-24 Years	>25 Years
Total							
Women	245	69	73	33	30	26	14
Men	881	151	258	181	109	100	82
Professor							
Women	43	1	1	9	8	15	9
% Women	17.6	1.4	1.4	27.3	26.7	57.7	64.3
Men	339	9	16	70	84	88	72
% Men	38.5	6.0	6.2	38.7	77.1	88.0	87.8
Associate Prof.							
Women	66	4	24	17	13	7	1
% Women	26.9	5.8	32.9	51.5	43.3	26.9	7.1
Men	262	9	121	97	18	12	5
% Men	29.7	6.0	46.9	53.6	16.5	12.0	6.1
Asst. Prof.							
Women	77	34	34	3	4	1	1
% Women	31.4	49.3	46.6	9.1	13.3	3.8	7.1
Men	209	94	103	8	2	–	2
% Men	23.7	62.3	39.9	4.4	1.8	–	2.4
Res. Assoc.							
Women	50	23	14	4	4	3	2
% Women	20.4	33.3	19.2	12.1	13.3	11.5	14.3
Men	61	30	17	6	5	–	3
% Men	6.9	19.9	6.6	3.3	4.6	–	3.7

*1976 Survey American Society for Cell Biology.

CELL BIOLOGY*

	Total	Experience Cohort					
		Under 5	5–9	10–14	15–19	20–24	>25
TOTAL							
Total	1455	340	402	260	184	152	117
Women	337	118	91	42	36	30	20
% Women	23.2	34.7	22.6	16.2	19.2	19.7	17.1
Avg. Salary W/M 75.8							
MED/DENT/VET SCHOOL							
Total	509	122	152	90	57	50	38
Women	111	38	38	14	9	9	3
% Women	21.8	31.1	25.0	15.6	15.8	18.0	7.9
Avg. Salary							
COLLEGE W/M 73.6							
Total	64	13	19	16	9	1	6
Women	23	7	7	2	5	1	1
% Women	35.9	53.8	36.8	12.5	55.5	100.1	6.3
Avg. Salary							
UNIVERSITY W/M 87.7							
Total	576	127	150	102	72	77	48
Women	132	50	29	16	13.	16	8
% Women	22.9	39.4	19.3	15.7	18.1	20.8	16.7
Avg. Salary W/M 74.1							
GOVERNMENT							
Total	137	41	35	19	20	10	12
Women	41	16	10	3	4	2	6
% Women	29.9	39.0	28.6	15.8	20.0	20.0	5.0
Avg. Salary W/M 90.2							

*1976 Survey American Society for Cell Biology.


MICROBIOLOGY
10,000
1000
100
10
Chairperson
Professor
Associate Professor
Assistant Professor
Instructor
Research Associate
Research Professor
Predoctoral
Postdoctoral
1950-51
1955-56
1960-61
1965-66
1970-71
1975-76

WOMEN MEMBERS ON NIH PUBLIC ADVISORY COMMITTEES*

September 30, 1976

Committee Function	Number Committees	Total Number Members	Number Women	% Women
Total	**164**	**1,977**	**378**	**19.1**
Policy and Program Advisory Councils and Boards	19	178	53	29.8
Initial Grant Review	77	1,045	184	17.6
Contract Review	27	342	58	17.0
Advisory Committees for Programs or Projects	13	126	23	18.3
Boards of Scientific Counselors	10	64	11	17.2
Initial Grant Review and Contract Review	18	222	49	22.1

Number and Percent of Women – 1971-1977

	Total Members	Women Members	% Female Membership
July 1, 1971	1,632	48	2.9
July 1, 1972	1,753	213	12.1
June 15, 1973	1,819	261	14.3
January 1, 1974	1,523	274	18.0
January 1, 1975	1,583	327	20.6
January 1, 1976	2,008	411	20.5
January 1, 1977	2,069	389	18.8

*NIH Committee Management Office.

NIH COMPETING RESEARCH PROJECTS (R01)
APPLICATIONS RECEIVED, RECOMMENDED AND AWARDED
1974–1977

	1974		1975		1976		1977	
	F	M	F	M	F	M	F	M
Received								
Total #	732	8060	722	8170	966	8584	1093	10888
Percent #	8.3	91.7	8.1	91.9	9.7	90.3	10.0	90.0
Percent $	7.7	92.3	7.2	92.8	8.6	91.4	9.2	90.8
Recommended								
Percent #	8.2	91.8	7.9	92.1	9.3	90.7	9.7	90.3
Percent $	7.3	92.7	7.4	92.6	8.4	91.6	9.0	91.0
Awarded								
Percent #	7.8	92.2	7.9	92.1	9.2	90.8	10.0	89.9
Percent $	6.9	93.1	7.3	92.7	8.3	91.7	9.1	90.9
Recommended/ Received								
Percent #	66.5	68.1	72.3	74.9	66.5	70.0	69.8	72.5
Awarded/ Recommended								
Percent #	57.7	60.8	67.0	66.7	55.7	56.3	48.0	46.0
Awarded/ Received								
Percent #	28.4	41.4	48.5	50.0	37.0	39.4	33.5	33.4

NIH, Division of Research Grants, Statistics and Analysis Branch.